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| APPLICATION NO.  | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO.     | CONFIRMATION NO. |
|--|-------------|----------------------|-------------------------|------------------|
| 09/869,277   | 06/26/2001  | Kiichi Hama          | 07553.0023              | 2374             |
| 22852  | 7590        | 05/19/2004           | EXAMINER                |                  |
| FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER<br>LLP<br>1300 I STREET, NW<br>WASHINGTON, DC 20005 |             |                      | UMEZ ERONINI, LYNETTE T |                  |
|  |             |                      | ART UNIT                | PAPER NUMBER     |
|  |             |                      | 1765                    |                  |

DATE MAILED: 05/19/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

|                              |                                     |                  |
|------------------------------|-------------------------------------|------------------|
| <b>Office Action Summary</b> | Application No.                     | Applicant(s)     |
|                              | 09/869,277                          | HAMA ET AL.      |
|                              | Examiner<br>Lynette T. Umez-Eronini | Art Unit<br>1765 |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

#### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

1) Responsive to communication(s) filed on 02 March 2004.  
 2a) This action is **FINAL**.                            2b) This action is non-final.  
 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

4) Claim(s) 1-25 is/are pending in the application.  
 4a) Of the above claim(s) 3,4,9-11 and 19 is/are withdrawn from consideration.  
 5) Claim(s) \_\_\_\_\_ is/are allowed.  
 6) Claim(s) 1,2,5-8,12-18, and 20-25 is/are rejected.  
 7) Claim(s) \_\_\_\_\_ is/are objected to.  
 8) Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

9) The specification is objected to by the Examiner.  
 10) The drawing(s) filed on \_\_\_\_\_ is/are: a) accepted or b) objected to by the Examiner.  
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).  
 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
 a) All    b) Some \* c) None of:  
 1. Certified copies of the priority documents have been received.  
 2. Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

1) Notice of References Cited (PTO-892)  
 2) Notice of Draftsperson's Patent Drawing Review (PTO-948)  
 3) Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
 Paper No(s)/Mail Date \_\_\_\_\_

4) Interview Summary (PTO-413)  
 Paper No(s)/Mail Date. \_\_\_\_\_.  
 5) Notice of Informal Patent Application (PTO-152)  
 6) Other: \_\_\_\_\_.

## **DETAILED ACTION**

This communication is in response to applicants' amendment filed on March 2, 2004. Allowable subject matter, "the length of time over which the oxygen is added into the process gas is short relative to the length of time over which the oxygen is not added into the process gas," which was found in the last Office action and incorporated in the independent claims 1, 7, and 17, has been found unpatentable, based on new prior art. Hence, a new art rejection is presented herein.

### ***Claim Objections***

1. Claim 5 is objected to under 37 CFR 1.75(c) as being in improper form because a multiple dependent should refer to other claims in the alternative only. See MPEP § 608.01(n). Accordingly, the claim has not been further treated on the merits.
2. Claim 12 is objected to under 37 CFR 1.75(c) as being in improper form because a multiple dependent claim 13. See MPEP § 608.01(n). Accordingly, the claim has not been further treated on the merits.
3. Claims 17 and are objected to because of the following informalities: On line 13, "ration" is misspelled. Appropriate correction is required.

### ***Claim Rejections - 35 USC § 112***

4. Claims 1-8 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 1, line 6, “the length of time . . . is short” is unclear because the term “small” is a relative term, which renders the claim indefinite.

In claim 5, line 3-5, “the relationship . . . the change . . . in the aspect ration . . . in the plasma composition . . . and the quantity of oxygen . . .;”

In claim 7, line 5, “the quantity of oxygen;”

In claim 7, line 7, “the quantity of oxygen;”

In claim 7, line 8, “the quantity of oxygen;”

In claim 12, line 3, “the quantity of oxygen;”

In claim 13, line 5, “the quantity of oxygen;”

In claim 13, line 6, “the aspect ratio;”

In claim 14, line 2, “the aspect ratio;”

In claim 14, line 3, “the quantity of;”

In claim 14, line 4, “the change;”

In claim 15, line 2, “the quantity of oxygen;”

In claim 16, line 2, “the quantity of oxygen;”

In claim 21, line 10, “the quantity of oxygen;”

In claim 22, line 3, “the quantity of oxygen;”

In claim 22, line 4, “the aspect ratio;”

In claim 23, line 7, “the quantity of oxygen;” and

In claim 23, line 8, “the aspect ratio;” lacks antecedent basis.

Claims 20 and 21 are indefinite for being similar in scope. There is no distinction between the claims.

***Claim Rejections - 35 USC § 102***

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claims 1, 2, and 6; 7-8; and 13-16 are rejected under 35 U.S.C. 102(b) as being anticipated by Babu et al. (US 5,053,104).

Babu teaches, “The plasma etching process. . . for plasma etching of semiconductor materials” (column 3, lines 17-20), “. . . and SiO<sub>2</sub> may all serve as the substrate” (column 3, lines 6-12). “In practicing one embodiment of the plasma etching process of the present invention, the specimen of the substrate material to be etched is mounted on one of the grounded electrodes of the reactor or in between a pair electrodes. The gas containing the organohalide (same as applicant’s fluorocarbon, process-gas) compound with or without oxygen is introduced into the reactor and a high frequency (RF) power is applied between the power and ground electrodes to produce a plasma between them” (column 3, lines 26-34). “In practicing another embodiment of this invention, the reactor is operated under non-steady state conditions. Such operation may be accomplished by repeatedly varying the etchant gas competition between organohalide-containing (same as applicant’s fluorocarbon, process-gas) and non-organohalide-containing (same as applicant’s oxygen) by alternating pulses of the etchant gas compositions” (column 3, lines 50-56). Babu further shows examples of

CF<sub>4</sub>/O<sub>2</sub> etchant having a former and less than 30 in the latter in Table IV and V. Hence the aforementioned reads on,

A plasma processing method for implementing a plasma process on a silicon oxide film layer formed at a workpiece placed inside a process chamber by generating plasma from a process gas containing, at least, fluorocarbon introduced into said process chamber, wherein; oxygen is intermittently added into the process gas, wherein;

oxygen is intermittently added into the process gas, and

the length of time over which the oxygen is added into the process gas is short relative to the length of time over which the oxygen is not added into the process gas, **in claim 1**;

A plasma processing method for implementing a plasma process on a silicon oxide film layer formed at a workpiece placed inside a process chamber by generating plasma from a process gas containing, at least, fluorocarbon introduced into said process chamber, wherein;

oxygen is added into the process gas and the quantity of oxygen added into the process is increased/decreased in relative measure, and

the length of time over which the oxygen is added into the process gas is short relative to the length of time over which the oxygen is not added into the process gas, **in claim 7**; and

the quantity of oxygen added into the process gas is increased/decreased cyclicly, **in claim 8**; and

a plasma processing method for implementing a plasma process on a silicon oxide film layer formed at a workpiece placed inside a process chamber by generating plasma from a process gas containing, at least, fluorocarbon introduced into said process chamber. Since Babu uses the same etchant and same method of etching a silicon oxide layer as in the claimed invention, then using Babu's method in the same manner as the claimed invention would inherently result in the quantity of oxygen added into the process gas is increased in proportion to an increase in the aspect ratio of a contact hole formed at said silicon oxide film layer, **in claim 13.**

The above aforementioned further reads on,

wherein oxygen is added into the process gas and the quantity of oxygen added into the process is increased; and wherein the quantity of oxygen added into the process gas is continuously increased, **in claim 15.**

Babu also teaches, "The substrate material is exposed to this organohalide containing plasma for about 0.5 to about minutes or until the etch rate has stabilized to its steady state valued, ... "Thereafter the gas atmosphere in the reactor is changed to essentially 100% by volume oxygen ..." (column 3, lines 34-43), which reads on,

wherein the oxygen is added after the plasma has stabilized, **in claim 6.**

### ***Claim Rejections - 35 USC § 103***

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

9. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Babu (US '104).

Babu differs in failing to teach a relationship between a change occurring the aspect ratio and a change occurring in the plasma composition is ascertained in advance and the quantity of oxygen added into the process gas is adjusted in proportion to the change in the plasma composition.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use known experimental methods of changing the aspect ratio and plasma composition in advance and adjusting the quantity of oxygen added into the process gas in proportion to the change in plasma in the Babu reference, including using applicants' method as claimed in the present invention for the purpose of improving the plasma etching process.

10. Claim 17-18 and 20-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Babu (US '104) in view of Koshiishi et al. (US 5,919,332).

Babu teaches, "The plasma etching process of the present invention is conveniently conducted in a parallel plate reactor of the type conventionally used for plasma etching of semi-conductor materials" (column 3, lines 17-20), "... and SiO<sub>2</sub> may all serve as the substrate" (column 3, lines 6-12). "In practicing one embodiment of the plasma etching process of the present invention, the specimen of the substrate material to be etched is mounted on one of the grounded electrodes of the reactor or in between a pair electrodes. The gas containing the organohalide (same as applicant's fluorocarbon, process-gas) compound with or without oxygen is introduced into the reactor and a high frequency (RF) power is applied between the power and ground electrodes to produce a plasma between them" (column 3, lines 26-34). "In practicing another embodiment of this invention, the reactor is operated under non-steady state conditions. Such operation may be accomplished by repeatedly varying the etchant gas competition between organohalide-containing (same as applicant's fluorocarbon, process-gas) and non-organohalide-containing (same as applicant's oxygen) by alternating pulses of the etchant gas compositions" (column 3, lines 50-56). The aforementioned reads on,

a plasma processing method for implementing a plasma process on a silicon oxide film layer formed at a workpiece placed on a second electrode by introducing a process gas containing, at least, fluorocarbon into a process chamber, wherein; oxygen is added intermittently added into the process gas; and

wherein oxygen is cyclically added into the process gas, **in claims 17, 20, 21, 22, and 23.**

Babu differs in failing to teach a contact hole is formed at said silicon oxide film layer, **in claims 17, 22, and 23.**

It is known to form a contact hole in a silicon oxide film.

It would have been obvious to one having ordinary skill in the art at the time of the claimed invention to use a known method of forming a contact hole in a silicon oxide in the Babu's reference, including using the method of the applicants as claimed in the present invention for the purpose of improving the plasma etching process.

Babu differs in failing to teach the frequency of the high-frequency power applied to said second electrode is lower than the frequency of the high-frequency power applied to said first electrode, **in claims 17, 20, and 21.**

Koshiishi teaches, "Thereafter, the upper electrode 21 is supplied with a high frequency power of frequency 27.12 MHz from the high frequency power source 47, and then, a plasma is generated between the upper electrode 21 and the susceptor 6. With a slight delay (about 1 second or less) from the generation of a plasma, the susceptor 6 is supplied with a high frequency power of frequency 800 kHz from the high frequency power source 44. Thus, by supplying a high frequency power for the susceptor 6 at a delayed timing, a wafer W is prevented from being damaged by an excessive voltage (column 17, lines 43-52).

It would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Babu by using Koshiishi's method of applying power to an electrode for the purpose of preventing the wafer from being damaged by excessive voltage (Koshiishi, column 17, lines 51-52).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lynette T. Umez-Eronini whose telephone number is 571-272-1470. The examiner is normally unavailable on the First Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571-272-1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Itue

May 7, 2004

**NADINE G. NORTON  
SUPERVISORY PATENT EXAMINER**

